Rehabilitation in Focal Segmental Glomerulosclerosis with Aspergillus bronchopneumonia: A Novel Case Study

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ABSTRACT

Focal Segmental Glomerulosclerosis (FSGS) is a unique type of long-term renal disease in which there is an indurated invasion of the glomerulus in particular segments picturized in the renal biopsy that terminates into an end-stage kidney dysfunction. Invasive pulmonary aspergillosis (IPA) is difficult diagnose fungal infection, as well as due to its rapid progression can lead to disseminated disease and death within weeks This case outlines the effect of physiotherapy rehabilitation in a case of FSGS with IPA in a 56-year-old man who presented with complaints of breathlessness, cough with expectoration and abdominal pain. Following investigations such as High-Resolution Computed Tomography (HRCT) scan, the patient was diagnosed with IPA for which he was kept under observation following which supervised Physiotherapy Intervention (PI) commenced. The outcome measure was Peak Expiratory Flow Rate (PEFR), whereas the intervention involved Diaphragmatic Breathing Exercises (DBEs), Breath Stacking Technique (BS), Incentive Spirometry (IS), Range of Motion (ROM) exercises, Active Cycle of Breathing Technique (ACBT), Inspiratory Muscle Training (IMT) and ambulation. After two weeks of treatment, there was an improvement in cough frequency, an appreciable change in vital capacity (VC) and a significant increase in PEFR values.

Keywords- Focal Segmental Glomerulosclerosis, Aspergillus bronchopneumonia, Physiotherapy Intervention, Breath Stacking Technique, Peak Expiratory Flow Rate.

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INTRODUCTION

Focal Segmental Glomerulosclerosis (FSGS) is a unique type of long-term renal disease in which there is an indurated invasion of the glomerulus in particular segments picturised in the renal biopsy that terminates into an end-stage kidney dysfunction (ESKD) (Kienzl-Wagner *et al.*, 2019). The incidence of FSGS is equally seen in both adults and children depending upon the etiological reasons such as genetic, infectious, drugs, toxins and co-morbidities like obesity, hypertension (HTN), diabetes mellitus (DM), etc (Podestà and Ponticelli, 2020). There is a reversible presentation in the symptoms of FSGS in the patients who have undergone renal transplant post-renal failure, biochemically revealing a remarkable fluctuation in the serum albumin and creatinine levels and is characterized by severe podocyte lesions which majorly contributes to the progression of this disease (Raina *et al.*, 2020). The Glomerular filtration rate is severely affected in FSGS as the podocyte causes an occlusive barrier resulting in protein-biased kidney disease (Frese *et al.*, 2019). The most typical clinical manifestations of FSGS are hyper-proteinuria, hypo-albuminemia, dyslipidemia, peripheral oedema and progressive hypertension causing renal dysfunction (Shamam and Hashmi, 2022).

In individuals with severe immunodeficiencies, invasive fungal infections are devastating or sometimes fatal. According to autopsy research on fungal infection, Aspergillus is more likely to impact the lungs than Candida, which most frequently affects the gastrointestinal tract. Patients with neutrophil deficiency, leukaemia or lymphoma, malignant tumors, chronic obstructive pulmonary disease (COPD) with long-term corticosteroid usage, or bacterial exacerbations are at risk of developing invasive pulmonary aspergillosis. Such fungi infections can cause widespread illness and death within weeks, and untreated invasive aspergillosis has a high mortality rate (Fan *et al.*, 2015).

Respiratory Physiotherapy (RP) also called pulmonary physiotherapy (PP) is a rehabilitative process that improves various pulmonary functions that get hampered due to any defunctive pulmonary condition and are carried out by a certified cardio-pulmonary physiotherapist (Troosters *et al.*, 2019). PP is manure usually carried out in patients admitted into the wards, under the surveillance of the intensive care unit (ICU) helping the patients revive various pulmonary issues such as decreased lung capacity, accumulation of secretions, etc. with multiple techniques such as chest PT, Active cycle of breathing technique (ACBT), Autogenic drainage (AD), Deep breathing exercises (DBE), and Incentive spirometry (IS) (Rodrigues *et al.*, 2020).

The breath stacking (BS) technique is one of the recently used techniques of RP in which there is a cyclic expansion of the lung resulting in the complete ventilation of the alveolar sacs, which works on the principle of expiratory occlusion (Macagnan, F. E et. al. 2022). BS technique is divided into two types, involuntary and voluntary breath stacking in which an assistive manual hyper-inflater and expiratory control by occlusion are performed respectively, both of these help in improving the pulmonary inspiratory capacity, elicit the retention of secretions and descends the chance of lung collapse (Chicayban *et al.*, 2020). The evaluation of the effect caused by conventional respiratory physiotherapy inclusive of BS technique in a patient with FSGS and Aspergillus bronchopneumonia is the goal of this case report.

CASE PRESENTATION

A 56 years old male presented with the complaint of severe breathlessness, cough with expectoration and abdominal pain with a past medical history of FSGS for 2 years, hypertension for 18 years and Diabetes mellitus for 15 years. On general examination, all vital parameters were noted such as heart rate (95 beats per minute), respiratory rate (14 breaths per minute), Peripheral Capillary Oxygen Saturation ($SpO2$ = 89%), and Peak Expiratory Flow Rate (PEFR = 400L/min). On assessment, abdominal pain was recorded as 4 on the Visual Analogue Scale (VAS) and Grade 5 breathlessness on the Modified Medical Research Council (mMRC) scale. On radiological investigation that includes a High-Resolution Computed Tomography (HRCT) scan of the chest revealed numerous cavitary lesions and randomised pulmonary nodules in the bilateral lung parenchyma. Additional investigations were carried out which includes sputum examination (KOH Mount), Erythrocyte Sedimentation Rate (ESR) and Renal Function Test. Based on these clinical findings and diagnostic assessment the patient was diagnosed with airway-invasive pulmonary aspergillosis also known as Aspergillus bronchopneumonia.

Before initiating Physiotherapy Intervention (PI) the main diagnostic assessment involved was PEFR which is a measure of the highest expiratory flow following maximal inspiration and was measured with a hand-held peak flow meter which was found to be 400L/min prior to treatment. Before commencing PI, the purpose of this case report was explained to the patient and informed consent was received before planning the therapeutic intervention following which supervised PI commenced. Physiotherapy regimen was performed for 25 minutes a day, for two consecutive weeks. Positioning was done from supine to supported sitting to prevent complications such as bed sores. Diaphragmatic Breathing Exercises (DBEs), and Breath Stacking technique (BS) with three sets of three to five repetitions for six days a week to facilitate controlled breathing & slow deep breathing and to increase inspired volumes that lead to greater peak cough flow, allowing for improvements in mucus clearance respectively. Additionally, three to five cycles of Active Cycle of Breathing Technique (ACBT) with three set for six days a week to facilitate airway clearance by loosening, collecting, and evacuating secretions along with Incentive Spirometry (IS) with three sets of six to eight repetitions for three days a week to facilitate visual feedback, and monitoring inspiratory effort were performed. Further, Inspiratory Muscle Training (IMT) device with three sets of six to eight repetitions for three days a week for increasing the inspiratory muscle strength was used, following which the patient was discharged.

To prevent circulatory and musculoskeletal complications, additional exercises performed once a day were ankle toe movements, heel slides with five sets of ten repetitions and active range of motion (ROM) exercises for bilateral upper and lower limbs with two sets of ten repetitions each. Aerobic exercises to improve functional capacities such as spot marching and ambulation were also inculcated in the PI.

Technique	Frequency	Repetitions	Sets
Diaphragmatic Breathing Exercises (DBE)	Six days per week	Three to Five	Three
Incentive Spirometry (IS)	Three days per week	Six to Eight	Three
Active Cycle of Breathing Technique (ACBT)	Six days per week	Three to Five	Three
Inspiratory Muscle Training (IMT)	Three days per week	Six to Eight	Three
Breath Stacking technique (BS)	Six days per week	Three to Five	Three

Table 1: Rehabilitation protocol

Follow-Up and Outcomes demonstrated that after two weeks of targeted respiratory PI, it was observed that there was an increase in the patient's functional capacity, reduced levels of dyspnoea and episodes of cough, improved sputum production, and a significant increase in the post PEFR values.

Outcome	Pre- treatment	Post- treatment
SpO2	89%	95%
Heart Rate	95 beats per min	80 beats per min
Respiratory rate	16 bpm	18 bpm
Breathlessness	Grade 5 on mMRC	Grade 2 on mMRC
PEFR	400 L/min	480 L/min

Table 2. Parameters describing pre-treatment and post-treatment values.

SpO2= Saturation of Peripheral Oxygen, PEFR= Peak Flow Meter Rate, bpm= breaths per min, mMRC= Modified Medical Research Council

DISCUSSION

This case report accentuates the impact of respiratory physiotherapy along with breath stacking technique in a patient diagnosed with focal segmental glomerulosclerosis (FSGS) and aspergillus bronchopneumonia. Respiratory physiotherapy is itself a broad term that consists of various techniques of respiratory rehabilitation. Individuals who are victims of chronic kidney disease and had undergone dialysis will have a severe pessimistic effect on their pulmonary function that can be improved with the assistance of respiratory physiotherapy (Simões *et al.*, 2020).

Lung expansion interventions, such as chest Physiotherapy exercises, deep breathing exercises, and continuous positive airway pressure, along with other medical interventions, can be effectively used to supervise Pulmonary Complications (PC). Fundamental measures like positioning and ambulation are probably best for reducing incidences of PC (Pathmanathan *et al.*, 2015). This research backs our case report that inferred, that post-treatment PEFR along with other vitals displayed significant improvement. Individuals diagnosed with pneumonia usually complain of difficulty in breathing and decreased pulmonary function along with secretions.

Introducing the breath stacking technique is more effective in descending pulmonary symptoms rather than the application of non-invasive ventilation along with the CPAP mask ("Comparative study between noninvasive ventilation with continuous positive airway pressure mask versus stacked breathing on chest expansion and pulmonary function in patients with pneumonia | Anaesthesia, Pain & Intensive Care," n.d.). In previous studies, the breath stacking technique has shown a positive impact on improving respiratory functions leading to augmentation of cough and lung compliance, thoracic expansion, secretions, and vital capacity (de Almeida *et al.*, 2020; Dorça *et al.*, 2020; "Comparative study between noninvasive ventilation with continuous positive airway pressure mask versus stacked breathing on chest expansion and pulmonary function in patients with pneumonia | Anaesthesia, Pain & Intensive Care," n.d.).

PEFR was considered as an outcome measure as this meter is easy to use and portable. Precedent studies have examined correlations between PEFR and other measures of pulmonary function. Additionally, they discovered a high correlation between reduced PEFR readings and respiratory symptoms as well as between PEFR with functional capacity and regular physical activity ("PEAK EXPIRATORY FLOW RATE IN AN ELDERLY POPULATION | American Journal of Epidemiology | Oxford Academic," n.d.).

Hence, a well-designed physiotherapeutic intervention brings about a reduction in PC, enhances the quality of life and promotes an early discharge from the hospital in patients with focal segmental glomerulosclerosis (FSGS) and aspergillus bronchopneumonia.

CONCLUSION

This case report concludes with the impact of conventional respiratory physiotherapy techniques along with the breath stacking technique in patients with focal segmental glomerulosclerosis (FSGS) and aspergillus bronchopneumonia. Pulmonary complications of varied etiology can occur in patients which delays the recovery process. There was a significant lack of literature for such a case previously. Hence, physiotherapeutic intervention showed significant improvement in vital capacity and post peak expiratory flow rate values thus, reducing pulmonary complications.

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